

**TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING
A FILING UNDER 35 U.S.C. 371**

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)

09/700371

INTERNATIONAL APPLICATION NO. PCT/EP99/02990

INTERNATIONAL FILING DATE
03 May 1999PRIORITY DATE CLAIMED
15 May 1998

TITLE OF INVENTION: EXPANSION LACE ASSEMBLY

APPLICANT(S) FOR DO/EO/US: Christof CALLSEN, Martin KRUSSMANN, Erik LULLWITZ and Hans-Rudolf SIEMUND

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:


1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371
3. ☐ This express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2)).
 - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ has been transmitted by the International Bureau
 - c. ☒ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). **(UNEXECUTED)**
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Item 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:

**23911**

PATENT TRADEMARK OFFICE

U.S. APPLICATION NO (if known, see 37 CFR 1.5) 09/700371		INTERNATIONAL APPLICATION NO PCT/EP99/02990		ATTORNEY'S DOCKET NUMBER 225/49317	
17. <input type="checkbox"/> The following fees are submitted: Basic National Fee (37 CFR 1.492(a)(1)-(5)):				CALCULATIONS	PTO USE ONLY
Search Report has been prepared by the EPO or JPO \$860.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) ... \$690.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) \$710.00 Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO \$ 1000.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) \$100.00 ENTER APPROPRIATE BASIC FEE AMOUNT =				\$860.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$130.00	
Claims	Number Filed	Number Extra	Rate		
Total Claims	17 - 20 =	0	X \$18.00	\$	
Independent Claims	1 - 3 =	0	X \$80.00	\$	
Multiple dependent claims(s) (if applicable)			+ \$270.00	\$	
TOTAL OF ABOVE CALCULATIONS =				\$990.00	
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).				\$	
SUBTOTAL =				\$	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$	
TOTAL NATIONAL FEE =				\$	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28,3.31). \$40.00 per property +				\$	
TOTAL FEE ENCLOSED =				\$990.00	
				Amount to be:	\$
				refunded	
				charged	\$
a. <input checked="" type="checkbox"/> A check in the amount of \$990.00 for the filing fee is enclosed b. <input type="checkbox"/> Please charge my Deposit Account No. _____ in the amount of \$_____ to cover the above fees. A duplicate copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees, which may be required, or credit any overpayment to Deposit Account No. <u>05-1323</u> . A duplicate copy of this sheet is enclosed. NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status. SEND ALL CORRESPONDENCE TO: Evenson, McKeown, Edwards & Lenahan, P.L.L.C. 1200 G Street, N.W., Suite 700 Washington, D.C. 20005 Tel. No. (202) 628-8800 Fax No. (202) 628-8844					
				 SIGNATURE NAME Donald D. Evenson REGISTRATION NUMBER 26,160 DATE Nov. 15, 2000	

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Attorney Docket: 225/49317
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: CALLSEN ET AL.

Serial No.: NOT YET ASSIGNED PCT No.: PCT/EP99/02990

Filed: November 15, 2000

Title: EXPANSION LANCE ASSEMBLY

PRELIMINARY AMENDMENT

Box PCT

November 15, 2000

Commissioner for Patents
Washington, D.C. 20231

Sir:

Please enter the following amendments to the English translation of the International Application, prior to the examination of the application during the U.S. National Phase.

IN THE SPECIFICATION:

Page 1, before line 1, delete everything in its entirety.

Page 1, after the title insert the following headings:

--BACKGROUND AND SUMMARY OF THE INVENTION--.

Page 1, line 4 and 5, delete "according to the precharacterizing clause of Patent Claim 1".

Page 1, line 8, before ". In" insert --(corresponding to U.S. Patent No. 5,054,756)--.

Page 2, line 38, delete "developing" and insert --providing--.

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Page 2, line 39, after "lance" delete "of the generic type to the extent that".

Page 3, line 1, delete "the lance" and insert --that--.

Page 3, line 4, before "invention" insert --features of the present-- and delete "by".

Page 3, line 5, delete "the features of Patent Claim".

Page 3, after line 32, insert the paragraph --Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings--.

Page 3, before line 34, insert the heading: --BRIEF DESCRIPTION OF THE DRAWINGS--.

Page 3, line 34 - 38, delete the paragraph beginning with "Expedient" and ending with "which:".

Page 4, after line 7, insert the heading: --DETAILED DESCRIPTION OF THE DRAWINGS--.

Page 4, line 12, delete "said".

Page 4, line 14, after "order" insert --,-- and after "example" insert --,--.

Page 12, after line 2, insert the following paragraph --The foregoing disclosure has been set forth merely to illustrate the invention and is not intended to be limiting. Since modifications of the disclosed embodiments incorporating the

spirit and substance of the invention may occur to persons skilled in the art, the invention should be construed to include everything within the scope of the appended claims and equivalents thereof--.

IN THE CLAIMS:

Please cancel all of the claims presently in the application and substitute new Claims 18-34 as follows:

-- 18. An expansion lance assembly for an expansion of a hollow profile by the exertion of a fluidic high internal pressure comprising:

a rod-shaped seal carrier detachably connected to a carrier holder and having a seal arrangement including at least two sealing rings each having an outside diameter which is larger than an inside diameter of the hollow profile and at least one spacer sleeve situated between the at least two sealing rings and arranged on the seal carrier, the seal carrier having an axial inflow bore connected to a fluid high-pressure source and at least one transverse bore branching off from the axial inflow bore and the seal arrangement having an axial end support situated remote from the carrier holder;

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the first component including a low-abrasion high-pressure-resistant elastomer ring which bears against a circumferential surface of the seal carrier such that it is elastically deformable axially by high internal pressure from the pressure source,

wherein the elastomer ring includes, on a side facing away from a nearest transverse bore, a peripheral shoulder on which the supporting ring is mounted, the peripheral shoulder being enclosed by the supporting ring, and the seal carrier and an axial stop being arranged on the peripheral shoulder.

19. The expansion lance according to Claim 18, wherein the elastomer ring includes a hydrolysis-resistant thermoplastic polyurethane elastomer.

20. The expansion lance according to Claim 18, wherein the supporting ring includes one of a linear aromatic polymer and a polyoxymethylene thermoplastic.

21. The expansion lance according to Claim 18, wherein the axial stop is formed by a spacer sleeve which is arranged with a snug fit on the seal carrier.

22. The expansion lance according to Claim 18, wherein the spacer sleeve is axially supported on a side facing away from the sealing ring against a positioning stop axially fixed on the seal carrier.

23. The expansion lance according to Claim 22, wherein the positioning stop includes two ring halves which are accommodated in an annular groove of the seal carrier and form a full ring, the two ring halves protruding radially out from the annular groove and being held together at their circumference by an elastomeric ring.

24. The expansion lance according to Claim 18, wherein the elastomer ring includes a peripheral sealing lip which protrudes radially outwardly from an outer circumference of the elastomer ring and includes a larger outside diameter than the inside diameter of the hollow profile to be expanded.

25. The expansion lance according to Claim 24, wherein the radially outwardly protruding sealing lips of two sealing rings are inclined towards each other.

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26. The expansion lance according to Claim 24, wherein the sealing lip of a trailing sealing ring of two sealing rings relative to a pushing-in direction of the expansion lance, includes on a side of the sealing ring ahead of it a peripherally chamfered radially outward-facing bevel.

27. The expansion lance according to Claim 24, wherein the elastomer ring has on a side facing away from the supporting ring a circumferential groove, which is open in an axial direction and the upper flank of which forms an underside of the sealing lip.

28. The expansion lance according to Claim 27, wherein the groove is between 2 and 2.3 mm deep.

29. The expansion lance according to Claim 27, wherein the groove is of a notch-shaped form, and a groove base is rounded.

30. The expansion lance according to Claim 18, wherein the elastomer ring has a peripheral sealing lip which protrudes radially inwards from an inner circumference of the elastomer ring and bears against the seal carrier with a prestress.

31. The expansion lance according to Claim 30, wherein the radially inwardly protruding sealing lips of two sealing rings are inclined towards each other.

32. The expansion lance according to Claim 30, wherein the sealing lip of a trailing sealing ring of two sealing rings relative to a pushing-in direction of the expansion lance, includes on a side of the sealing ring ahead of it, a peripherally chamfered radially inward-facing bevel.

33. The expansion lance according to Claim 30, wherein a flexible stripping ring, which has a greater diameter than the inside diameter of the hollow profile, is attached onto the seal carrier, ahead of the sealing arrangement relative to a pushing-in direction of the expansion lance.

34. The expansion lance according to Claim 18, wherein the seal carrier includes a hardened and tempered steel.

IN THE ABSTRACT:

Please substitute the new Abstract of the Disclosure submitted herewith on a separate page for the original Abstract presently in the application.

REMARKS

Entry of the amendments to the English translation of the specification and claims before examination of the application in the U.S. National Phase is respectfully requested.

Serial No. TO BE ASSIGNED

If there are any questions regarding this Preliminary Amendment or this application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #225/49317).

Respectfully submitted,



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ABSTRACT OF THE DISCLOSURE

An expansion lance assembly for an expansion of a hollow profile by the exertion of a fluidic high internal pressure. The expansion lance assembly includes a rod-shaped seal carrier detachably connected to a carrier holder and having a seal arrangement including at least two sealing rings. At least one spacer sleeve is situated between the at least two sealing rings and is arranged on the seal carrier. The seal carrier has an axial inflow bore connected to a fluid high-pressure source and at least one transverse bore branching off from the axial inflow bore. To provide that the lance can be used for long periods of time with a reliable seal of the seal arrangement, the expansion lance assembly includes that each of the sealing rings includes a first component and a second component. The first component includes a low-abrasion high-pressure-resistant elastomer ring which bears against a circumferential surface of the seal carrier such that it is elastically deformable axially by high internal pressure. The second component includes a high-pressure-resistant supporting ring which is radially elastic and axially has a high tensile strength. Furthermore, the elastomer ring includes, on a side facing away from a nearest transverse bore, a peripheral shoulder on which the supporting ring is mounted.

DaimlerChrysler AG
Stuttgart

Expansion lance assembly

The invention relates to an expansion lance according
5 to the precharacterizing clause of Patent Claim 1.

An expansion lance of the generic type is known from DE
37 16 986 A1. In this case, a rod-shaped seal carrier
has a sealing arrangement pushed onto it (Figure 2),
10 the said sealing arrangement comprising spacer sleeves,
pairs of sealing rings and intermediate sleeves, the
latter being arranged between the sealing rings of the
pairs. The sealing rings are supported on the other
hand against the spacer sleeves or an end stop. In the
15 case of an expansion lance of this type, in which, in
the position in which it has been pushed into a pipe to
be expanded, the sealing rings bear against the inside
of the pipe with prestress, the sealing rings are
pressed into the gap between the spacer sleeves
20 adjoining the sealing rings, or the end stop, and the
pipe when a high internal pressure is applied, intended
to bring about a partial expansion of the pipe, after
which the respective ring undergoes extrusion through
the gap. This causes irreparable damage to the ring,
25 which may lead immediately to leakage of the sealing
arrangement. What is quite sure, however, is that the
extruded ring must be exchanged before a subsequent
expanding process is carried out by means of the
expansion lance, so there can be no question of the
30 expansion lance being capable of being used over long
periods. Figures 5a and 6a of the document show
versions of the sealing arrangement in which the
sealing rings in the form of O-rings are placed in
receiving grooves, the O-rings having to be stretched
35 over a special spacer sleeve to assume their intended
place. Furthermore, although the O-rings have

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supporting elements on the side facing away from the expansion location, there is a gap both between the supporting element and the pipe to be expanded and between the latter and the O-ring, as a result of which no sealing effect exists during the build-up of the high internal pressure via the gap. Although under high internal pressure the O-ring is deformed until it bears against the inside of the pipe, the ring is squeezed into the gap between the supporting element and the pipe in spite of the support (Figure 5a). In this case, extrusion of the ring through the gap likewise occurs to a certain extent. In the version of Figure 6a, the supporting ring itself may be extruded, after which the O-ring is extruded. Consequently, the expansion lance cannot be used over long periods. This similarly applies to the versions of Figures 7 and 8, the O-rings not primarily having a sealing function here but instead serving as pressure transferring means for the supporting element and being intended to press the latter against the inside of the pipe for applying the sealing effect. In this case, however, the admission pressure in the region 9 must be just as great as the joining pressure in the expansion region, since otherwise the O-ring is pressed into the bore lying thereunder. If the joining pressure is greater, the bore under the O-ring acts like a punching ring, which destroys the O-ring. If there is pressure equalisation, at the customary rates of pressure increase of approximately 2000 bar/sec the bore under the O-ring acts like a nozzle, which blasts the O-ring with the pressurized fluid. Since the supporting element is subjected directly to the pressure medium and the force resulting from the two compressive forces has an axial component, the supporting element may either easily jam in the gap between the spacer sleeve and the hollow profile or even be extruded into it.

The invention is based on the object of developing an expansion lance of the generic type to the extent that

the lance can be used over long periods while ensuring a reliable sealing effect of the sealing arrangement.

The object is achieved according to the invention by
5 the features of Patent Claim 1.

Thanks to the invention, the sealing arrangement of the expansion lance has a priori as a result of the oversize of the elastomer sealing ring with respect to
10 the inside diameter of the hollow profile to be partially expanded an adequate sealing effect during the pressure build-up phase. In this case, the low-abrasion material of the sealing ring contributes significantly to ensuring that the expansion lance can
15 be used over long periods. On account of the axially immovable stop, when there is full expansion pressure the elastomer ring is axially compressed, after which the axially unyielding, but radially elastic supporting ring is radially expanded by the radially swelling
20 shoulder until it is pressed against the inside of the hollow profile. There is accordingly no gap between the hollow profile and the sealing ring into which the elastomer ring could flow, i.e. be extruded, thereby avoiding sealing damage and consequently consolidating
25 the long-term service life of the expansion lance. The elastomer ring cannot flow away at any other point either, since its shoulder is always enclosed by the supporting ring, the seal carrier and the stop. At the same time, the fact that the elastomer ring does not
30 flow away ensures the sealing effect during the expansion of the hollow profile subjected to high internal pressure.

Expedient developments of the invention can be taken
35 from the subclaims; moreover, the invention is explained in more detail below on the basis of an exemplary embodiment represented in the drawings, in which:

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Figure 1 shows a portion of an expansion lance according to the invention in a lateral longitudinal section,

- 5 Figure 2 shows a sealing ring of the sealing arrangement of the expansion lance according to Figure 1 in a lateral longitudinal section.

Represented in Figure 1 is an expansion lance assembly
10 1, with which a straight-running tubular hollow profile can be partially expanded by exertion of a fluidic high internal pressure after the said expansion lance has been pushed in and suitably positioned within the hollow profile, in order for example to join cams onto
15 the hollow profile to form a camshaft.

The expansion lance 1 comprises a rod-shaped seal carrier 2, which is detachably attached, preferably screwed, onto a carrier holder. The seal carrier 2 has
20 a centrally running axial inflow bore 3, from which transverse bores 4 branch off at specific intervals, adapted to the placement of the cams to be joined on the hollow profile, and open out at the point of the hollow profile expansion to be formed. The inflow bore
25 3 on the one hand has connected to it a fluid high-pressure source for charging the inflow bore 3, and consequently the expansion point, with a pressurized fluid. On the other hand, the inflow bore 3 is designed as a blind-hole bore, which runs out in an
30 upset portion 6 of the seal carrier 2, which forms the end of the latter. The upset portion 6 serves as an end stop for a sealing arrangement 7, which can be pushed in a simple way onto the seal carrier 2, without the seals of the arrangement 7 being stretched
35 inordinately, entailing damage to the seal.

The sealing arrangement 7 comprises sealing rings 8, as can be seen in particular from Figure 2, spacer sleeves 9, intermediate sleeves 10 and positioning stops 11.

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The sealing rings 8 are respectively provided as a pair of sealing rings and are arranged at the point of the expansion lance 1 at which the expansion of the hollow profile is to take place. The spaced-apart sealing rings 8 of the pair of sealing rings in this case axially bound the expansion point on both sides in such a way that it is sealed against high pressure, so that an annular expansion chamber 12 is formed between the sealing rings 8. The expansion chamber 12 is virtually filled with in each case an intermediate sleeve 10, which has radial bores 13 which adjoin the mouth openings of the transverse bores 4 of the expansion lance 1 in such a way that they are aligned with the bores 4. On the side 14 facing away from the intermediate sleeve 10, the sealing rings 8 are supported by an axial stop, which is designed as a spacer sleeve 9. This serves at the same time as a line filler for axially positioning the sealing rings 8 along the expansion lance 1.

The spacer sleeve 9 in turn is supported on the other hand axially against a positioning stop 11, which is fastened axially immovably on the seal carrier 2. The stop 11 absorbs the axial force which originates on the one hand from the high internal pressure exerted in the expansion chamber 12 and on the other hand from the frictionally induced insertion forces when the expansion lance 1 is pushed into the hollow profile, so that no axial displacement of the sealing rings 8 and of the spacer sleeves 9 occurs under the effect of the compressive force. The positioning stop 11, which does not necessarily have to support every spacer sleeve 9 - two pairs of sealing rings lying next to each other may also be supported against a common spacer sleeve 9 lying between the pairs - is formed in an easy-to-assemble way by two ring halves 15, 16, which are accommodated in an annular groove 17 of the seal carrier 2 to form a full ring. In their inserted position, the ring halves 15, 16 protrude radially out

of the annular groove 17, being held together against each other at their circumference by a torsionally flexible elastomeric ring 18.

- 5 The upset portion 6 may also be replaced by a positioning stop 11 formed in such a way, whereby the seal carrier 2 can be formed with less expenditure in terms of technical production, namely as a simple cylindrical rod. Then, to ensure the tightness of the seal of the expansion lance 1 in its end region, that is to say in the region of the positioning stop 11, the inflow bore 3 is welded closed.

- 15 The sealing rings 8 are formed with oversize at the outside diameter with respect to the inside diameter of the hollow profile, so that when the expansion lance 1 is pushed into the hollow profile a sealing effect is immediately obtained by the sealing rings 8 bearing with prestress against the inside of the hollow profile. Furthermore, the sealing rings 8 in each case comprise two components, the first component being formed by a low-abrasion high-pressure-resistant elastomer ring 19, which bears against the circumferential surface 5 of the seal carrier 2.

- 25 The elastomer ring 19 can consequently be axially subjected fully to the high internal pressure and can be elastically deformed in its entirety. It preferably consists of a hydrolysis-resistant thermoplastic polyurethane elastomer, its low abrasion during pushing into and pulling out of the hollow profile guaranteeing a high long-term durability. It is possibly also conceivable for the elastomer ring 19 to be formed from a textile material, in particular an aramid braid.

- 35 The elastomer ring 19 has a peripheral sealing lip 20 which protrudes radially outwards from its outer circumference and has a much greater outside diameter than the inside diameter of the hollow profile to be

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expanded. The radially outwardly protruding, spread-away sealing lips 20 of the two sealing rings 8 of the pair of sealing rings are inclined towards each other, as a result of which, when the expansion lance 1 is pushed into the hollow profile, the sealing lips 20 are bent by the latter strongly towards the seal carrier 2, so that the prestress of the sealing rings 8 in the hollow profile, and consequently the sealing effect, is increased. In addition, the sealing lips 20 bridge the gap, increasing during the expansion, between the expansion lance 1 and the hollow profile by elastically springing back into their initial position, corresponding to the not-in-use position of the expansion lance 1. In this case, relatively large gaps can be bridged in such a way that they are sealed against high pressure in an advantageous way. Furthermore, the outside dimensions of the other component parts of the sealing arrangement 7 can be reduced without loss of a sealing effect, so that jamming of the expansion lance 1 in the hollow profile during the pushing in and/or during the action of the high internal pressure, during which distortions of the seal carrier 2 can occur, can be prevented. The design of the sealing lips 20 also has the effect of technically facilitating the production of the sealing arrangement 7, since much greater production tolerances are permissible with the reduced diameter of the expansion lance 1. The inclination of the sealing lip 20 also brings the advantage that, when a high internal pressure is exerted, the lips 20 are additionally pressed radially against the inside of the hollow profile with an extremely high force, whereby on the one hand the sealing capability of the sealing arrangement is increased considerably and on the other hand this contributes considerably to avoiding extrusion of the sealing ring 8 into the gap between the non-expanded region of the expansion lance 1 and the hollow profile.

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For better threading of the sealing lips 20 into the hollow profile and for avoiding breaking off of the trailing sealing ring 8 in the pushing-in direction of the expansion lance 1 when the expansion lance 1 is pushed in or of the leading sealing ring 8 in the pushing-in direction of the expansion lance 1 when the expansion lance 1 is pulled out after the forming operation, the sealing lip 20 has on the side of the intermediate sleeve 10 a peripherally chamfered radially outward-facing bevel 21 (Figure 2).

Incorporated in the elastomer ring 19 is a notch-shaped annular groove 22, which is open in the axial direction towards the intermediate sleeve 10 and the outer flank of which forms the underside 23 of the sealing lip 20. The annular groove 22 gives the sealing lip 20 adequate elasticity to be able to spring back appropriately during the expansion of the hollow profile to ensure adequate sealing capability. In this case, the depth of the annular groove 22 should not be made so great that there is the risk of the sealing ring 8 tearing, but great enough to ensure adequate elasticity of the sealing lip 20. Groove depths of between 2 and 2.3 mm have been found to be particularly favourable here. The groove base 24 is, moreover, rounded for technical stress-related reasons, whereby the notch stress of the annular groove 32 is reduced and the strength of the sealing ring 8 is increased.

The elastomer ring 19 also has a peripheral sealing lip 25 which protrudes radially inwards from its inner circumference and bears against the seal carrier 2 with prestress, avoiding creeping of the high-pressure fluid under the sealing ring 8 and consequently the formation of a leak. The sealing effect is consequently increased by the sealing lip 25. In the same way as the sealing lip 20, the radially inwardly protruding sealing lips 25 of the two sealing rings 8 of the pair of sealing rings are inclined towards each other,

whereby the sealing lips 25 are pressed very strongly against the seal carrier 22 under high internal pressure and improve the sealing effect still further.

5 The sealing lip 25 has a peripherally chamfered radially inward-facing bevel 26, which facilitates the threading onto the seal carrier 2 for the trailing sealing ring 8 of the pair of sealing rings in the pushing-in direction of the expansion lance 1, and
10 prevents breaking off of the sealing lip 25 when threading on, and prevents breaking off for the leading sealing ring 8 in the pushing-in direction of the expansion lance 1 when pulling off from the seal carrier 2, for example for the purpose of replacement.

15 Formed on the elastomer ring 19, on the side 14 of the latter facing away from the nearest transverse bore 4, is a peripheral, cross-sectionally rectangular shoulder 27, onto which a supporting ring 28 forming the
20 abovementioned second component of the sealing ring 8 is mounted with a press fit. The supporting ring 28 mounted in such a way consists of high-pressure-resistant material, is radially elastic and has a very high tensile strength in the axial direction. Bronze
25 or a spring steel is conceivable as the material for the supporting ring 28. The use of a linear aromatic polymer or a polyoxymethylene thermoplastic has been found to be particularly favourable with respect to satisfying the requirements to be met by the supporting
30 ring 28. The shoulder 27 of the sealing ring 8 is consequently enclosed by the supporting ring 28, the seal carrier 2 and the adjacent spacer sleeve 9.

35 If a high internal pressure is then built up, on the one hand the sealing lip 20 is pressed against the hollow profile and on the other hand the elastomer ring 19 is axially subjected to the fluid. In this case, the said ring is compressed between the spacer sleeve 9 and the pressurized fluid and, as a result, ring

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material is additionally pressed under the supporting ring 28, which radially expands, driven as it were by the swelling shoulder 29 of the elastomer ring 19, and presses itself against the hollow profile. As a result, the gap between the expansion lance 1 and the hollow profile is closed directly behind the expansion region, the elastomer ring 19 having no possibility of being extruded into the gap and destroyed in this way, with loss of sealing capability. The supporting ring 28 is very stiff in the axial direction and therefore cannot be pressed away or even extruded itself. Consequently, the supporting ring 28 achieves a reliable sealing effect for the sealing arrangement 7 and ensures that the expansion lance 1 can be used over long periods. To prevent any creeping under the spacer sleeve 9 by the shoulder 27 of the elastomer ring 19, the sleeve 9 is arranged with a snug fit on the seal carrier 2.

The intermediate sleeve 10, keeping the two sealing rings 8 of the pair of sealing rings apart and supporting them axially, virtually fills the expansion chamber 12, as mentioned, in order to lose as little pressurized fluid as possible when the expansion lance 1 is pulled out from the hollow profile after expansion has taken place. In order that the pressurized fluid can flow to an adequate extent via the radial bores 13 into the annular groove 22 for the compression of the elastomer ring 19 and for the spreading of the sealing lips 20 and 25, the intermediate sleeve 10 is provided on the outside with a bevel 29 on both end faces.

A flexible stripping ring 31, which has a greater diameter than the inside diameter of the hollow profile, is attached, preferably adhesively attached, onto the end face 30 of the upset portion 6 of the seal carrier 2, ahead of the sealing arrangement 7 in the pushing-in direction of the expansion lance 1. The stripping ring 31 serves for displacing particles,

chips and loose burr in the hollow profile, so that the sealing rings 8 have a clean contact when they come to bear in their position for use in the hollow profile, which is important for the sealing capability of the sealing arrangement 7. Furthermore, the sealing rings 8 are not scratched by the small particles mentioned and therefore do not suffer any damage, so that this aspect also contributes to the ability of the expansion lance 1 to be used over long periods.

10

The seal carrier 2 consists, moreover, of a hardened and tempered steel with a high yield strength and high tensile strength with at the same time a high elongation at fracture, with the effect of reducing the growing axial loading due to the pressure increasing and decreasing, which lowers the tensile strength of the seal carrier 2 during its use, in particular whenever it has a very small diameter. The tensile strength then becomes so low that the seal carrier 2 ruptures. The sealing effect would in this case be lost. The hardening and tempering decisively counteract this harmful effect. The seal carrier 2, produced from originally normal tool steel (for example 60 WCrV 7) is subjected to a suitable heat treatment for this purpose. For example, the steel is austenitized in a furnace at 880°C for a heat exposure period of approximately 25 minutes and is then cooled from the heat of the furnace to room temperature in oil. Subsequently, the steel is annealed for 2 hours at 600°C, after which it has a yield strength of approximately 1340 N/mm² and a tensile strength of approximately 1410 N/mm² with an elongation at fracture A5 of approximately 8%. As an alternative to this steel, a heat-treatable steel such as 30 CrNiMo 8, which is extremely tough, can conceivably be used. On account of the hardening and tempering of the seal carrier 2, very stiff sealing elements of the sealing arrangement 7, such as metal spacer sleeves 9 and

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supporting rings 28, can also be used, since bending of the seal carrier 2 does not occur during the expansion.

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DaimlerChrysler AG
Stuttgart

Patent claims

1. Expansion lance assembly for the partial expansion
of a a straight-running tubular hollow profile by
5 exerting a fluidic high internal pressure, with a
rod-shaped seal carrier detachably attached to a
carrier holder, with a sealing arrangement which
comprises at least two sealing rings formed with
oversize at the outside diameter with respect to
10 the inside diameter of the hollow profile and at
least one spacer sleeve placed between the pair of
sealing rings and the carrier holder and is
arranged on the seal carrier, which has an axial
inflow bore connected to a fluid high-pressure
15 source and at least one transverse bore branching
off from the inflow bore and opening out between
the pair of sealing rings, and with an axial end
support of the sealing arrangement remote from the
holder, characterized in that the sealing rings (8)
20 in each case comprise two components, the first
component being formed by a low-abrasion high-
pressure-resistant elastomer ring (19), which bears
against the circumferential surface (5) of the seal
carrier (2) in such a way that it can be
25 elastically deformed axially by the high internal
pressure, and the second component being formed by
a high-pressure-resistant supporting ring (28),
which is radially elastic and axially has a very
high tensile strength, and in that the elastomer
30 ring (19) has on its side (14) facing away from the
nearest transverse bore (4) a peripheral shoulder
(37), on which the supporting ring (28) is mounted
and which is enclosed by the supporting ring (28),
the seal carrier (2) and an axial stop (9) arranged
35 on the latter.

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- 5
2. Expansion lance according to Claim 1, characterized in that the elastomer ring (19) consists of a hydrolysis-resistant thermoplastic polyurethane elastomer.
- 10
3. Expansion lance according to Claim 1, characterized in that the supporting ring (28) consists of a linear aromatic polymer or a polyoxymethylene thermoplastic.
- 15
4. Expansion lance according to Claim 1, characterized in that the axial stop is formed by a spacer sleeve (9), which is arranged with a snug fit on the seal carrier (2).
- 20
5. Expansion lance according to Claim 1, characterized in that the spacer sleeve (9) is axially supported on its side facing away from the sealing ring against a positioning stop (11) axially fixed on the seal carrier (2).
- 25
6. Expansion lance according to Claim 5, characterized in that the positioning stop (11) comprises two ring halves (15, 16), which are accommodated in an annular groove (17) of the seal carrier (2) to form a full ring, and protrude radially out of the annular groove (32), being held together at their circumference by an elastomeric ring (18).
- 30
7. Expansion lance according to Claim 1, characterized in that the elastomer ring (19) has a peripheral sealing lip (20) which protrudes radially outwards from its outer circumference and has a much greater outside diameter than the inside diameter of the hollow profile to be expanded.
- 35
8. Expansion lance according to Claim 7, characterized in that the radially outwardly protruding sealing

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lips (20) of the two sealing rings (8) of the pair of sealing rings are inclined towards each other.

- 5 9. Expansion lance according to Claim 7, characterized in that the sealing lip (20) of the trailing sealing ring (8) of the pair of sealing rings in the pushing-in direction of the expansion lance (1) has on the side of the sealing ring (8) ahead of it a peripherally chamfered radially outward-facing
10 bevel (21).
- 15 10. Expansion lance according to Claim 7, characterized in that the elastomer ring (19) has on its side facing away from the supporting ring (28) a circumferential groove (22), which is open in the axial direction and the upper flank of which forms the underside (23) of the sealing lip (20).
- 20 11. Expansion lance according to Claim 10, characterized in that the groove (22) is between 2 and 2.3 mm deep.
- 25 12. Expansion lance according to Claim 10, characterized in that the groove (22) is of a notch-shaped form, the groove base (24) being rounded.
- 30 13. Expansion lance according to Claim 1, characterized in that the elastomer ring (19) has a peripheral sealing lip (25) which protrudes radially inwards from its inner circumference and bears against the seal carrier (2) with prestress.
- 35 14. Expansion lance according to Claim 13, characterized in that the radially inwardly protruding sealing lips (25) of the two sealing rings (8) of the pair of sealing rings are inclined towards each other.

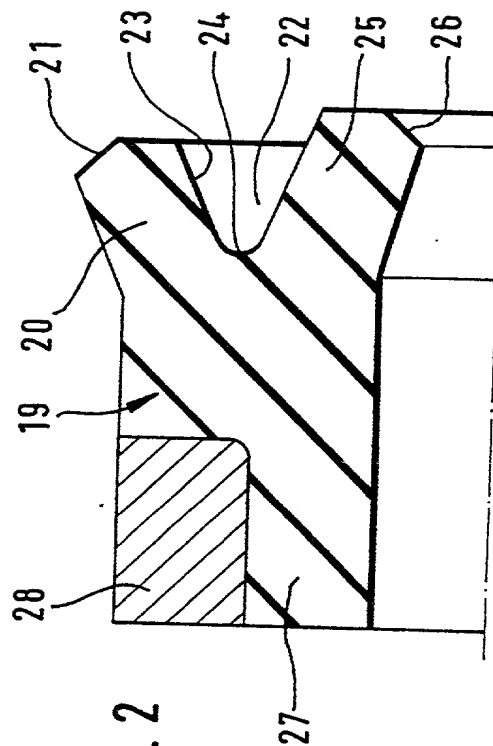
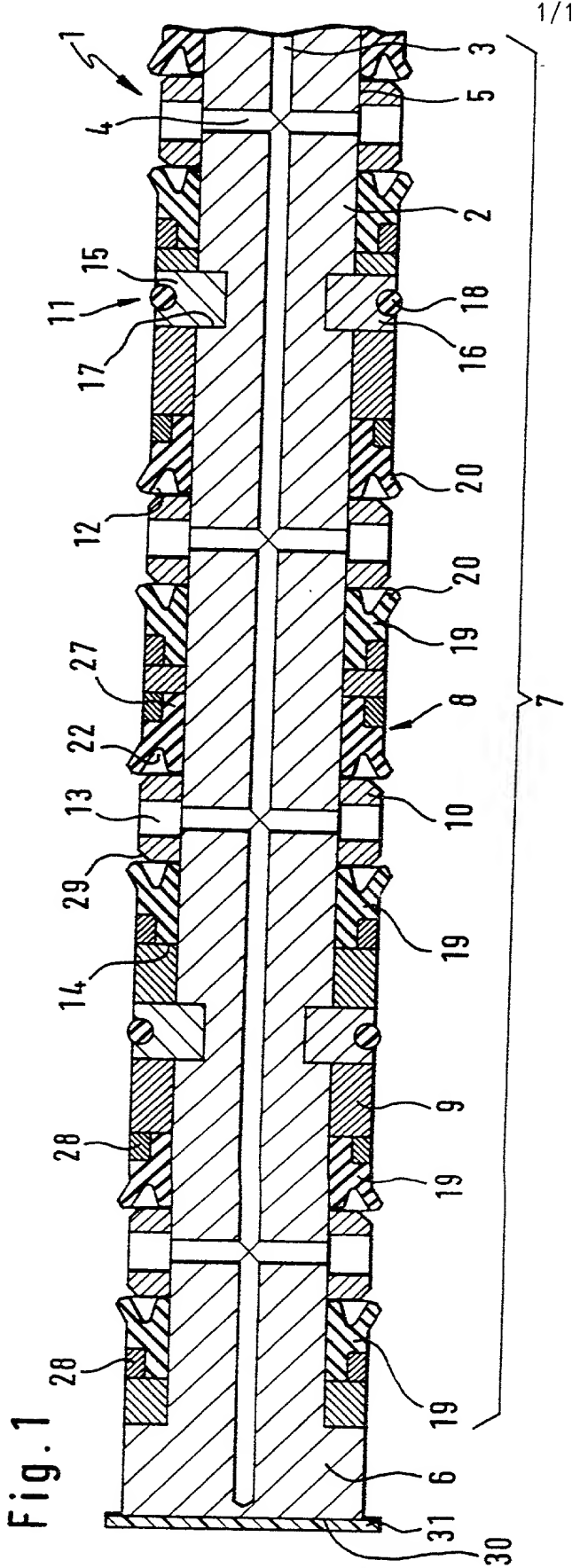
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15. Expansion lance according to Claim 13, characterized in that the sealing lip (25) of the trailing sealing ring (8) of the pair of sealing rings in the pushing-in direction of the expansion lance (1) has on the side of the sealing ring (8) ahead of it a peripherally chamfered radially inward-facing bevel (26).
16. Expansion lance according to Claim 13, characterized in that a flexible stripping ring (31), which has a greater diameter than the inside diameter of the hollow profile, is attached onto the seal carrier (2), ahead of the sealing arrangement (7) in the pushing-in direction of the expansion lance (1).
17. Expansion lance according to Claim 1, characterized in that the seal carrier (2) consists of a hardened and tempered steel.

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Abstract

The invention relates to an expansion lance assembly for the partial expansion of a straight-running tubular hollow profile by exerting a fluidic high internal pressure. The lance comprises a rod-shaped seal carrier detachably attached to a carrier holder, a sealing arrangement which comprises at least two sealing rings formed with an oversize at the outside diameter with respect to the inside diameter of the hollow profile and at least one spacer sleeve placed between the pair of sealing rings and the carrier holder and is arranged on the seal carrier, which has an axial inflow bore connected to a fluid high-pressure source and at least one transverse bore branching off from the inflow bore and opening out between the pair of sealing rings, and an axial end support of the sealing arrangement remote from the holder. To achieve the effect that the lance can be used over long periods while ensuring a reliable sealing effect of the sealing arrangement, it is proposed that the sealing rings in each case comprise two components, the first component being formed by a low-abrasion high-pressure-resistant elastomer ring, which bears against the circumferential surface of the seal carrier in such a way that it can be elastically deformed axially by the high internal pressure, and the second component being formed by a high-pressure-resistant supporting ring, which is radially elastic and axially has a very high tensile strength, and that the elastomer ring has on its side facing away from the nearest transverse bore a peripheral shoulder, on which the supporting ring is mounted and which is enclosed by the supporting ring, the seal carrier and an axial stop arranged on the latter.



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Attorney Docket: 225/49317
09/700371 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: CHRISTOF CALLSEN ET AL

Serial No.: 09/700,371

Filed: NOVEMBER 15, 2000

Title: ASSEMBLED EXPANDING LANCE

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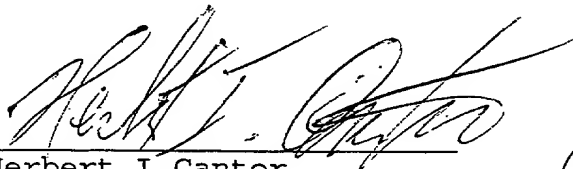
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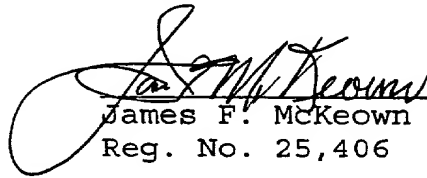
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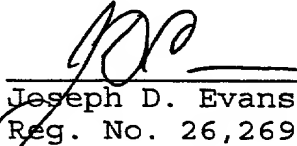
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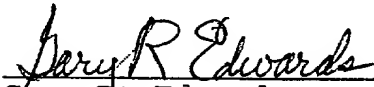
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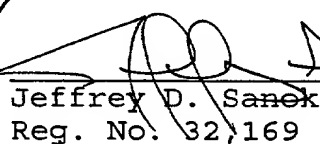
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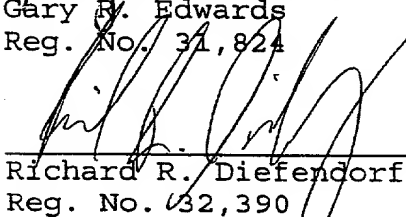
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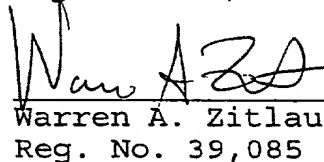
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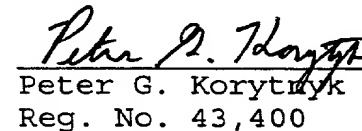
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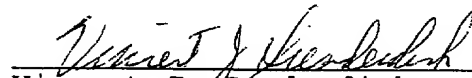
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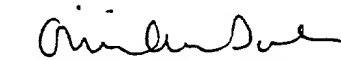
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Washington, D.C.
May 1, 2001
Ref.2156/02474

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY
(includes Reference to PCT International Applications)ATTORNEY'S
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225/49317

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Expansion Lance Assembly

the specification of which (check only one item below):

☐ is attached hereto.☐ was filed as United States application

Serial No. _____

on _____

and was amended

on _____ (if applicable).

☒ was filed as PCT international applicationNumber PCT/EP99/02990on 3 May 1999 (03.05.99)

and was amended under PCT Article 19

on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations. §1.56(a).

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COUNTRY (if PCT indicate PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 USC 119
Germany	19821807.9	15 May 1998 (15.05.98)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
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			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
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Combined Declaration For Patent Application and Power of Attorney (Continued)
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I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

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PCT APPLICATIONS DESIGNATING THE U.S.

PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (IF ANY)			

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